# January, 2004 Report of the Tevatron BPM Upgrade wbs item 1.3.4.6.4 Bob Webber, Stephen Wolbers February 7, 2004

## **Project Manager's Summary:**

In January the project started to focus intently on two major lines of work. First, measurements were made with a Recycler Echotek board using 53 MHz filters on the input, and processing the 53 MHz signal. This setup was used to measure closed-orbit positions and to attempt to measure turn-by-turn positions. The intent is to expand the capability of this prototype system to output the I and Q signals for testing the p/pbar separation technique. All of these studies are crucial to establishing that the proposed system can provide measurements consistent with the requirements for a new Tevatron BPM system.

The other main line of activity was to make progress on the full system design of the new system – both hardware and software. The timing, diagnostics and calibration systems were all discussed and some progress was made in early design. Much work remains there before a full system is designed. There was also progress in the software specification and design, which will hopefully lead to software specification documents and internal sign-off in February.

In response to the a recommendation from the technology choice review and because it is a good idea Jim Steimel has been appointed Technical Coordinator of the Tevatron BPM Upgrade Project. Jim will help to prioritize the work, focus the activities where needed, and bring people and expertise to the project where required. Jim has the qualifications to do a good job here and we believe that this appointment will help the project move rapidly toward constructing a successful new system.

The test stand in the Feynman Center is established and has connection to ACNET and soon to the TCLK and Beam Synch Clock systems.

Jim Steimel gave a talk in the break out sessions of the Temple Review. Others helped to prepare the documents that were submitted to the Temple Review.

Much work goes on to refine the wbs for the Tevatron BPM system, including cleaning up the major (DOE) milestones and updating the work accomplished up to now.

### **Resources Used in January 2004:**

The total number of FTE-months devoted to the project in calendar January 2004 in the Computing Division was reported to be 5.1 FTE-months, and 12 people contributed. Estimated effort expended in the Accelerator Division was 1.7 FTE-months, and 4 people, in January 2004. The total effort from both Divisions was 6.8 FTE-months. The

following table gives the estimated or reported effort for both divisions (in FTE-months) since August of 2003.

Month	AD Effort	CD Effort	Total Effort
August, 2003	1.2	2.3	3.5
September, 2003	1.4	4.1	5.5
October, 2003	5.4	6.0	11.4
November, 2003	1.6	5.0	6.6
December, 2003	1.4	4.4	5.8
January, 2004	1.7	5.1	6.8

No purchase requisitions were placed in January.

All earlier purchases are listed here:

PO 554435 PO 553812 PO 553679 PO 545187	\$1,100 \$4,330 \$0 \$21,099	Bandpass filters Connectors Connectors (order cancelled) Electrician Services
BLM prototype parts:		
Pro-Card Pro-Card	\$295 \$585	PCI2PMC Adapter PCM-DIO
Tunnel/Cabling:		
Pro-Card Pro-Card	\$403 \$1590	BNC Plug 39F1030 Connectors
Echotek D&B Report	\$123	
Total	(\$33,426)	

## **Milestones:**

There were no major (DOE) milestones in January 2004.

## Meetings held, Reports Given:

Meetings were held in January on the following dates:

January 7,8,12,14,15,22,26,28,29 -- Project meetings

January 23 -- Software Specification Meeting

January 20-22 -- Temple Review

### **Documents:**

The following documents were written and added to the Accelerator Division Document Database in December:

Bob Webber, "A View of Bunch Crossings vs. Time and Location Around the TeV", January 2, 2004, AD Doc 959.

Mark Fischler, "Strategies For Measuring Resolution of new BPM Electronics", January 6, 2004, AD Doc 960-v4.

Bob Webber, "Description of Conditions of VA14 and HA15 BPM Proton and Pbar Signals During Position Scan", January 12, 2004, AD Doc 967.

Jim Steimel, "Tev BPM Commissioning", January 12, 2004, AD Doc 969.

Bob Webber, "Tevatron BPM Resolution Demonstration", January 15, 2004, AD Doc 977.

Margaret Votava, Luciano Piccoli, Dehong Zhang, Brain Hendricks, "Tevatron Beam Position Monitor Upgrade Software Specifications for Data Acquisition", January 21, 2004, AD Doc 860-v7.

Robert Kutschke, "Cancellation of the Proton Signal on the Antiproton Cable: A Status Report", January 30, 2004, AD Doc 988.

### **Subproject Leader Reports:**

#### **Technical Coordinator: Jim Steimel**

The technical coordinator position was created and assigned in the middle of January. During this time I have put most of my focus on developing and analyzing methods for measuring pbar signals in the presence of protons. Three activities occurred in parallel during this month on this topic. First, the simulation model of the BPM was refined to include effects of non-linear coupling. Second, stretched wire measurements of a Tevatron BPM were started to confirm the model. Third, data from a BPM installed in the Tevatron was logged for different beam positions on three different acquisition systems. The three systems produced consistent results.

The analysis of the data taken from the different beam positions is still being analyzed, and a plan for an additional dedicated study with more position points is nearly complete. Data from the stretched wire measurements should be available in early February.

A subset of the recycler system was modified and installed in the Tevatron for testing. The tests confirmed that the hardware will meet the resolution requirements for the closed orbit measurement of protons. The hardware was also modified to make turn-by-turn measurements, and data from this measurement will be taken and analyzed early next month.

Other activities include providing the Tevatron department with a baseline-commissioning plan that involves commissioning each crate during brief shutdowns, continuing work on BPM data storage content and organization, and the start of specifying the triggering hardware.

Next month we hope to have decided on the pbar measurement technique. Also, we hope to have the data storage, timing and diagnostics systems specified well enough to allow the software specification to be completed.

### **Electronics: Vince Pavlicek**

During December, the electronics group participation in the hardware meeting discussions was focused specifically on the timing and diagnostic hardware needed to satisfy the requirements. Several meetings with the recycler BPM hardware designers have helped us to understand the timing in that system. TeV BPM hardware meetings were used to transform that operation over to the Tevatron while reviewing the requirements. Our first step was to examine whether the recycler hardware could satisfy the Tevatron needs. Much of the hardware is useful with a few unanswered questions for the rest. Then the existing capabilities and the required and needed capabilities were compared. The final input to this process was that some amount of future capabilities

might be added. Comments were collected from the BPM committee and some additional personnel with appropriate weighting. This data gathering should lead to a proposal for the trigger and diagnostic hardware from he electronics group very early in February.

The data collection going on in the A1 service building and the associated signal processing are necessary to confirm that the proposed hardware satisfies the requirements but the design and development should proceed on the assumption that this confirmation will arrive very soon.

## Front-end/DAQ software: Margaret Votava

January was a busy month now that the readout modules have been selected. We've spent time in getting ready for the software specifications document review in particular looking at ACNET/SSDN device mapping onto the buffer requirements document and state machines. This is flushing out the finer detail of the buffer requirements. Calibration and diagnostics still remain unspec'ed while waiting on requirements for this functionality. The timing architecture will also have a large impact on the spec document as well.

We've spent time analyzing the Recycler BPM software. We've modified it to return I and Q values for fast time plotting in the A1 test stand. We hope to have a plan on how to restructure to meet the Tevatron requirements in February.

The FCC test stand now has fiber configured for accessing the Beams network and clock signals. Some hardware still needs to be installed to receive the clocks. We have a crate controller booting into the BD infrastructure, and the rpbm code loads, but is not ready to run yet. The test stand has one Echotek module and the start of the timing hardware has just now been acquired - pmcucd card and the I/O boards.

### **Online software: Brian Hendricks**

During this month, the BPM data structures were updated. New structures were created to support returning time slices of BPM and BLM data to view beam activity over time. The metadata in the data header was also modified to include information requested by the Tevatron and Integration departments. In addition, work was begun on the online software specification.

## Offline software: Rob Kutschke

The early part of January was spent consolidating the work done in December. After that, two major data analysis projects were undertaken. One project was to analyze data taken by Bob Webber during a dedicated 12x0 proton only study period on Jan 10. During this time the beam was moved, both horizontally and vertically, and the signals on the cables were recorded using the damper board electronics. This data was used to

develop an improved algorithm for cancellation of the proton contamination on the antiproton cables. The best cancellation algorithm reduces the contamination to less than 2% of its raw magnitude.

The second major project was a reanalysis of some old data using the new algorithm for cancelling the proton contamination. In particular the data presented at the December 2003 review of the technology choice were reanalyzed. We now see a robust antiproton signal for the full data-taking period. Moreover the antiproton beam moves, qualitatively, equal and opposite to the proton beam. However the antiproton position appears to be off by several mm. This is currently under investigation.

This work has been written up as document Beams-doc-988.